Tolerance of Different Wheat Cultivars (*Triticum* SPP.) to Salinized Water

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ABSTRACT

Relative salt tolerance of different wheat cultivars (*Triticum aestivum* and *T. durum*) was studied under the greenhouse conditions at the Faculty of Agriculture, Alfateh University, Tripoli, in 1975–1976.

Seedling emergence was delayed due to the increase in salinity of irrigation water during the first stage of emergence (7 days). However, no significant effect was noted due to salinity on the emergence percentage of the different wheat cultivars after this stage.

Although plant height at harvest in the wheat cultivars was not significantly affected by levels of salinity, spike length was reduced due to the increase in salinity level. The cultivars tested differed in stem and spike length. While Florence Aurora gave the tallest stems followed by Sidi Misri 1 and El-Badri, Sidi Misri 1 gave the longest spikes followed by Florence Aurora then El-Badri.

The average number of tillers and spikes per plant were decreased due to irrigation with salinized water. On the other hand, no significant effect of cultivars was exerted on both tillering and number of spikes per plant.

The total yield (grain plus straw), grain yield and straw yield were decreased by the increase of salinity level in irrigation water. The wheat cultivars were similar with respect to these measurements.

Although the harvest index (percentage grain to total yield) was not significantly affected by salinity level, the cultivars had a highly significant effect on it. Sidi Misri 1 gave a highly significant greater harvest index (30.39%) than either El-Badri or Florence Aurora which gave almost equal harvest index values (17.58 and 17.46%), respectively.

The number of grains per plant was decreased due to irrigation with salinized water. On the other hand, the number of grains per spike were not significantly affected by salinity. Sidi Misri 1 gave the maximum number of grains per plant, number of grains per spike, and grain weight per spike when compared with the other two cultivars.

Grain size was not affected by the salinity level up to 6,000 ppm, but it was highly significantly reduced with further increase in salinity. On the other hand, wheat cultivars gave comparable grain size.

It was concluded that the reduction in yield due to salinized water was attributed, mainly, to reduction in number of fertile tillers per plant.

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INTRODUCTION

Short- and tall-straw wheat cultivars were found to be affected differently when irrigated with salinized water (1,6). Asseed *et al.* (1) indicated that irrigation with salinized water up to 6,000 ppm increased grain yield of wheat per plant as well as other yield components. Straw yield was significantly reduced due to salinity and, therefore, resulting in higher grain to straw ratio in the short wheat 'Sidi Misri 1'.

Sorour *et al.* (6) reported that seedling emergence of the tall-straw wheat cultivar 'Florence Aurora' was delayed by increasing the salinity level in the first week after sowing. However, emergence percentage were comparable for different salinity levels at late stages of emergence. On the other hand, total yield, grain yield, and number of spikes and grains per plant were decreased by increasing salinity.

El-Kobbia *et al.* (4) found that the growth and yield of wheat plants were not affected by salinity levels up to 20,000 ppm.

Higher salt tolerance and resistance to drought had been reported by several workers (2,3,5) due to treatments with Cycocel (CCC). The interaction between salinity levels and Cycocel in wheat was previously indicated (1,6).

This work was carried out to study the relative tolerance of different wheat cultivars to salinized water.

MATERIALS AND METHODS

A pot experiment was conducted in the greenhouse at the Faculty of Agriculture Farm, Alfateh University, Tripoli during 1975–1976 to study the combined effect of salinity level of irrigation water and different wheat cultivars on growth, yield and yield components.

The experiment consisted of four salinity treatments, namely, plain tap water, 3,000 ppm, 6,000 ppm, and 9,000 ppm of 1:1 NaCl and $CaCl_2$. Moreover, three wheat cultivars were included, viz. El-Badri, (*Triticum durum* L.), Sidi Misri 1, and Florence Aurora (*Triticum aestivum* L.). A randomized complete block design, with three replicates and twelve treatments, was used.

Ten grains of wheat were planted per pot on November 18, 1975, using standard pots, 12 cm deep and 20 cm in diameter with drainage facilities. The pots were filled with dried and sieved soil of the Faculty Farm (69.7% sand, 19.2% silt, 10% clay and 7.44 $CaCO_3$). The electric conductivity of 1:1 soil extract was 0.41 mmhos/cm at 25°C which indicated low salt content of the soil.

Emerged seedlings were counted periodically from their appearance until the end of the emergence stage and the emergence percentage was estimated. Plants were thinned to five plants per pot six weeks after planting, the average fresh and dry weight per seedling was determined. Ten grams per pot of a compound fertilizer ($12N - 24P_2O_5 - 12K_2O$) was added in two splits at six and nine weeks after planting. Six tensiometers were installed in the root zone, and the pots were irrigated to their field capacity whenever the average tensiometer readings reached 35–40 centibars.

At maturity (150 days after planting) the pots were harvested to determine average values for plant height, spike length, number of tillers per plant, number of spikes per plant, total yield (grain plus straw) per pot, grain yield per pot, straw yield per pot, harvest index, number of grains per plant, grain weight per spike and number of grains per spike.

RESULTS AND DISCUSSION

I. Effects on growth

The average seedling emergence percentage, as affected by salinity levels, in the different wheat cultivars is presented in Table 1 and Figures 1, 2 and 3. Generally, salinity caused a delay in seedling emergence in all wheat cultivars when compared with the

Table 1 The effect of salinity levels on the average emergence percentages of different wheat cultivars.

Treatments		Days after sowing			
Cultivars	Salinity levels	7	9	11	15
El-Badri	Tap water	57	80	93	97
	3000 ppm	33	57	97	97
	6000 ppm	27	53	93	97
	9000 ppm	17	43	93	100
Sidi Misri 1	Tap water	40	63	83	93
	3000 ppm	20	33	77	93
	6000 ppm	30	47	83	97
	9000 ppm	20	47	77	97
Florence Aurora	Tap water	30	63	97	100
	3000 ppm	37	73	90	93
	6000 ppm	20	37	83	87
	9000 ppm	13	67	97	97
L.S.D.	(0.05)	1.7	N.S.[a]	N.S.	N.S.
L.S.D.	(0.01)	2.4	N.S.	N.S.	N.S.

[a]N.S. = Not significant.

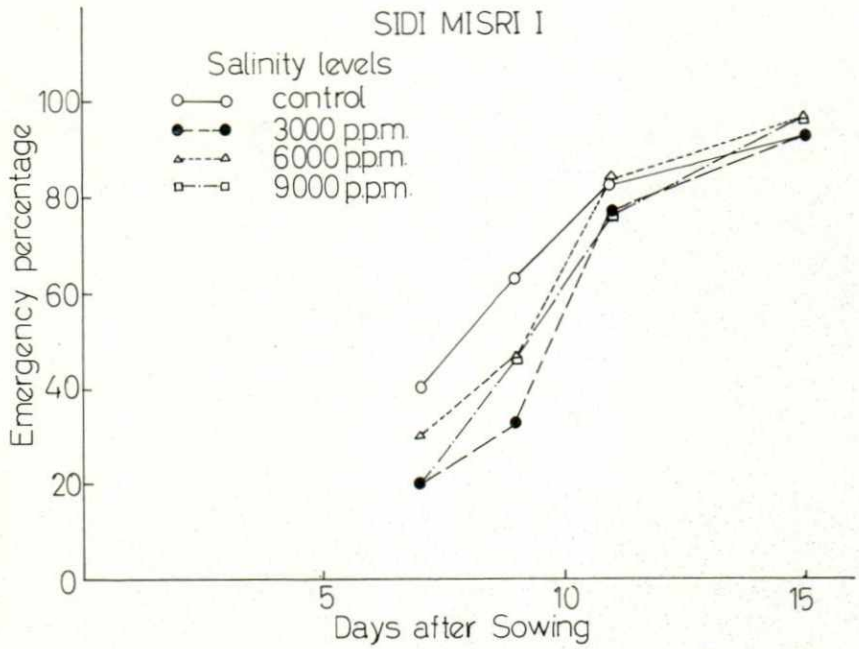

Fig. 1. Effect of salinity levels on the emergence percentage in Sidi Misri 1 wheat cultivar.

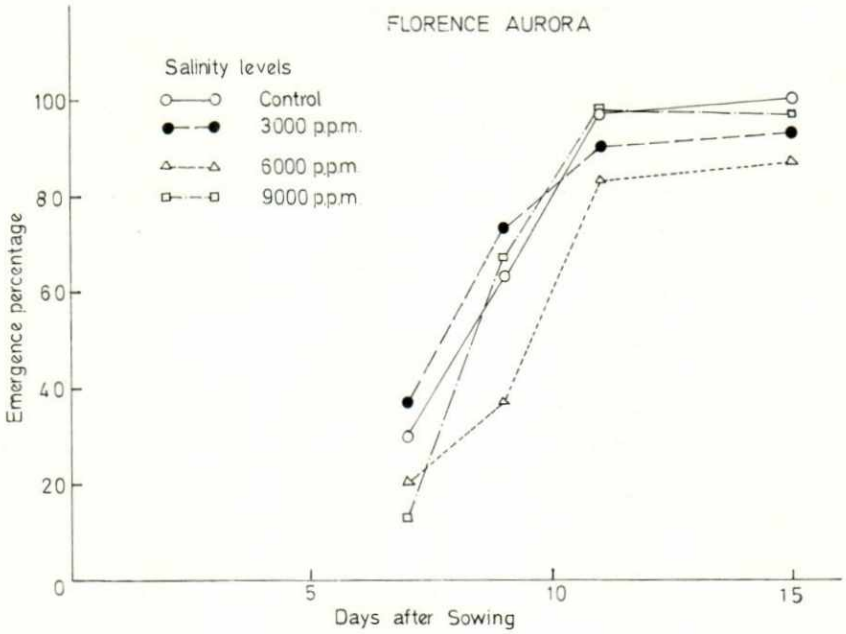

Fig. 2. Effect of salinity levels on the emergence percentage in Florence Aurora wheat cultivar.

control treatment (tap water). Highly significant differences were obtained among the different treatments up to 9 days from sowing after which comparable results were obtained for both salinity and cultivars.

The results in Tables 2 and 3 show that although the average fresh and dry weights per plant after six weeks from sowing were not affected significantly by the salinity

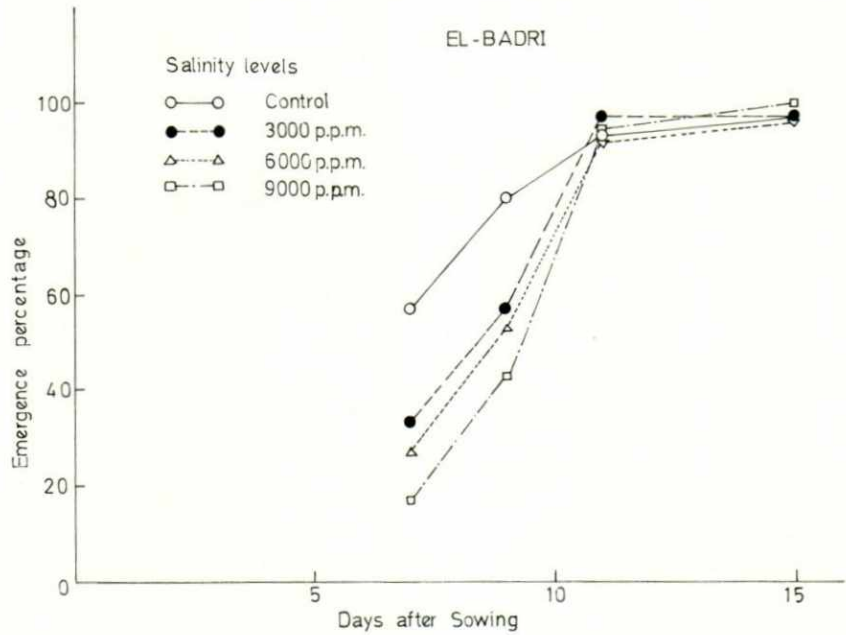

Fig. 3. Effect of salinity levels on the emergence percentage in El-Badri wheat cultivar.

Table 2 The effect of salinity levels on the average fresh weight per plant of different wheat cultivars six weeks after sowing(g).

Cultivars	Salinity levels				Mean[a]
	Tap water	3000 ppm	6000 ppm	9000 ppm	
El-Badri	0.73	0.60	0.98	0.69	0.75
Sidi Misri 1	0.81	1.06	0.87	0.82	0.89
Florence Aurora	1.00	1.04	1.24	0.85	1.03
Mean	0.85	0.90	1.03	0.79	—

[a] L.S.D. (for cultivars): (0.05) = 0.36 & (0.01) = 0.48 g/plant.

Table 3 The effect of salinity levels on the average dry weight per plant of different wheat cultivars six weeks after sowing(g).

Cultivars	Salinity levels				Mean
	Tap water	3000 ppm	6000 ppm	9000 ppm	
El-Badri	0.17	0.16	0.23	0.19	0.19
Sidi Misri 1	0.18	0.25	0.20	0.22	0.21
Florence Aurora	0.24	0.23	0.26	0.25	0.25
Mean	0.20	0.21	0.23	0.22	—

levels, Florence Aurora gave the maximum average fresh and dry weights per plant followed by Sidi Misri 1 and El-Badri.

Plant height at harvest, as presented in Table 4, was not significantly affected by different salinity levels. However, the wheat cultivars differed significantly in their stem length. Florence Aurora gave the tallest (47.2 cm) and El-Badri the shortest (34.7 cm) stems, while Sidi Misri 1 proved to be of intermediate stem length (41.3 cm).

Table 4 The effect of salinity levels on the average plant height of different wheat cultivars at harvest (cm).

Cultivars	Salinity levels				Mean[a]
	Tap water	3000 ppm	6000 ppm	9000 ppm	
El-Badri	35.4	37.3	36.7	29.5	34.7
Sidi Misri 1	45.4	46.9	37.5	35.4	41.3
Florence Aurora	45.8	49.3	48.8	44.9	47.2
Mean	42.2	44.5	41.0	36.6	—

[a] L.S.D. (for cultivars): (0.05) = 5.0 & (0.01) = 6.8 cm.

Spike length was significantly affected by both salinity levels and cultivars, as shown in Table 5. The increase in salinity level caused the average spike length to decrease. These results were in close agreement with previous reports (1,6). On the other hand, there were highly significant differences between cultivars in spike length. Sidi Misri 1 was superior to the other two cultivars with respect to spike length (5.7 cm). El-Badri gave the shortest spike compared to the other tested cultivars.

Table 5 The effect of salinity levels on the average spike length of different wheat cultivars (cm).

	Salinity levels				
Cultivars	Tap water	3000 ppm	6000 ppm	9000 ppm	Mean[a]
El-Badri	3.4	3.6	3.4	2.9	3.3
Sidi Misri 1	6.1	5.8	5.9	5.1	5.7
Florence Aurora	5.4	4.5	5.1	4.1	4.8
Mean[b]	5.0	4.6	4.8	4.0	—

[a] L.S.D. (for cultivars): (0.05) = 0.6 & (0.01) = 0.8 cm.
[b] L.S.D. (for salinity levels): (0.05) = 0.7 cm.

Data in Tables 6 and 7 indicate that both the average number of tillers and spikes per plant were decreased due to the increase in salinity. Highly significant differences were obtained between the control and all other salinity treatments. These results confirmed the previous findings (6). The wheat cultivars tested were comparable in both tillering and number of spikes per plant.

Table 6 The effect of salinity levels on the average number of tillers per plant of different wheat cultivars.

	Salinity levels				
Cultivars	Tap water	3000 ppm	6000 ppm	9000 ppm	Mean
El-Badri	2.5	1.1	1.0	1.1	1.4
Sidi Misri 1	2.2	1.1	1.2	1.0	1.4
Florence Aurora	2.9	1.2	1.0	1.0	1.5
Mean[a]	2.5	1.1	1.1	1.8	—

[a] L.S.D. (for salinity levels): (0.05) = 0.3 & (0.01) = 0.4 tiller/plant.

Table 7 The effect of salinity levels on the average number of spikes per plant of different wheat cultivars.

	Salinity levels				
Cultivars	Tap water	3000 ppm	6000 ppm	9000 ppm	Mean
El-Badri	1.5	1.0	0.9	0.7	1.0
Sidi Misri 1	1.5	0.9	0.8	0.9	1.0
Florence Aurora	1.9	0.9	0.6	0.7	1.0
Mean[a]	1.6	0.9	0.8	0.8	—

[a] L.S.D. (for salinity levels): (0.5) = 0.25 & (0.01) = 0.34 spike/plant.

The results of Tables 8, 9, and 10 indicate that the total yield (grain plus straw) grain yield, and straw yield per pot were significantly decreased due to increase in salinity. Highly significant differences were obtained between the control and all other treatments. Irrespective of salinity level, no significant differences in these parameters were found among the tested cultivars.

Table 8 The effect of salinity levels on the average total yield (grain plus straw) per pot of different wheat cultivars at harvest (g).

	Salinity levels				
Cultivars	Tap water	3000 ppm	6000 ppm	9000 ppm	Mean
El-Badri	8.1	5.1	4.5	3.3	5.3
Sidi Misri 1	7.6	5.7	3.7	4.3	5.3
Florence Aurora	10.7	4.8	5.3	4.0	6.3
Mean[a]	8.9	5.2	4.5	3.9	—

[a] L.S.D. (for salinity levels): (0.05) = 1.65 & (0.01) = 2.24 g/pot.

Table 9 The effect of salinity levels on the average grain per pot of different wheat cultivars (g).

	Salinity levels				
Cultivars	Tap water	3000 ppm	6000 ppm	9000 ppm	Mean
El-Badri	1.73	1.20	0.83	0.33	1.02
Sidi Misri 1	2.60	1.90	1.00	1.20	1.68
Florence Aurora	2.76	0.83	0.93	0.60	1.28
Mean[a]	2.36	1.31	0.92	0.71	—

[a] L.S.D. (for salinity levels): (0.05) = 1.05 & (0.01) = 1.43 g/pot.

Table 10 The effect of salinity levels on the average straw yield per pot of different wheat cultivars (g).

	Salinity levels				
Cultivars	Tap water	3000 ppm	6000 ppm	9000 ppm	Mean
El-Badri	6.36	3.86	3.66	2.93	4.20
Sidi Misri 1	5.03	3.80	2.70	3.13	3.66
Florence Aurora	8.13	3.93	4.36	3.40	4.96
Mean[a]	6.51	3.86	3.57	3.15	—

[a] L.S.D. (for salinity levels): (0.05) = 1.32 & (0.01) = 1.79 g/pot.

The harvest index (percentage of grain to total yield), as indicated in Table 11, was not affected significantly by the salinity levels. However, there were significant differences in the harvest indecies among tested cultivars with Sidi Misri 1 having the

Table 11 The effect of salinity levels on the average harvest index (percentage grain to total yield) of different wheat cultivars.

	Salinity levels				
Cultivars	Tap water	3000 ppm	6000 ppm	9000 ppm	Mean[a]
El-Badri	20.93	21.50	18.37	9.50	17.58
Sidi Misri 1	33.66	32.70	26.72	28.43	30.39
Florence Aurora	23.57	17.57	16.13	12.57	17.46
Mean	26.05	23.92	20.42	16.83	—

[a] L.S.D. (for cultivars): (0.05) = 9.30 & (0.01) = 12.65%.

highest value of 30.39% (compared to 17.58 and 17.46% for El-Badri and Florence Aurora, respectively).

The results in Table 12 indicate that the average number of grains per plant was significantly affected by the salinity levels and cultivars. Generally, the number of grains per plant was decreased with the increase in salinity. However, differences were significant only between the control and all other salinity treatments. As to the effect of cultivars, Sidi Misri 1 gave the highest average number of grains per plant, while El-Badri and Florence Aurora showed comparatively lower average numbers.

Table 12 The effect of salinity levels on the average number of grains per plant of different wheat cultivars.

	Salinity levels				
Cultivars	Tap water	3000 ppm	6000 ppm	9000 ppm	Mean[a]
El-Badri	9.53	8.07	5.93	3.40	6.73
Sidi Misri 1	18.83	15.13	12.03	12.10	14.53
Florence Aurora	16.47	5.43	4.93	5.20	8.01
Mean[b]	14.94	9.54	7.63	6.90	—

[a] L.S.D. (for cultivars): (0.05) = 5.12 & (0.01) = 6.90 grains/plant.
[b] L.S.D. (for salinity levels): (0.05) = 5.90 grains/plant.

Data in Tables 13 and 14 show that both average grain weight and number per spike were not significantly affected by salinity levels. However, both components of yield

Table 13 The effect of salinity levels on the average grain weight per spike of different wheat cultivars (g).

	Salinity levels				
Cultivars	Tap water	3000 ppm	6000 ppm	9000 ppm	Mean[a]
El-Badri	0.20	0.24	0.18	0.10	0.18
Sidi Misri 1	0.37	0.43	0.32	0.26	0.35
Florence Aurora	0.32	0.23	0.41	0.15	0.28
Mean	0.30	0.30	0.30	0.17	—

[a] L.S.D. (for cultivars): (0.05) = 0.13 g/spike.

Table 14 The effect of salinity levels on the average number of grains per spike of different wheat cultivars.

	Salinity levels				
Cultivars	Tap water	3000 ppm	6000 ppm	9000 ppm	Mean[a]
El-Badri	5.83	8.07	6.13	4.70	6.18
Sidi Misri 1	12.77	17.17	16.27	13.53	14.93
Florence Aurora	8.70	6.47	10.27	7.07	8.13
Mean	9.10	10.57	10.89	8.43	—

[a] L.S.D. (for cultivars): (0.05) = 3.68 & (0.01) = 5.01 grains/spike.

were similarly affected by the wheat cultivars. Sidi Misri 1 gave higher weight and greater number of grains per spike than either El-Badri or Florence Aurora.

Grain size, as indicated in Table 15, was significantly affected by the salinity levels. Although the increase in salinity level up to 6,000 ppm had no significant effect, further increase above that level caused a highly significant reduction in grain size. On the other hand, the tested cultivars did not differ significantly with respect to grain size.

Table 15 The effect of salinity levels on the average 1000-grain weight of different wheat cultivars (g).

	Salinity levels				
Cultivars	Tap water	3000 ppm	6000 ppm	9000 ppm	Mean
El-Badri	30.60	25.80	35.00	20.00	27.85
Sidi Misri 1	29.67	25.27	20.57	19.27	23.69
Florence Aurora	31.50	37.63	34.93	13.97	29.51
Mean[a]	30.59	29.57	30.17	17.74	—

[a] L.S.D. (for salinity levels): (0.05) = 9.38 g.

In general, under the conditions of this experiment, it might be concluded that the salinized water greatly reduced the yield of wheat cultivars through the significant reduction in number of spike-bearing tillers per plant. Other yield components were slightly affected.

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